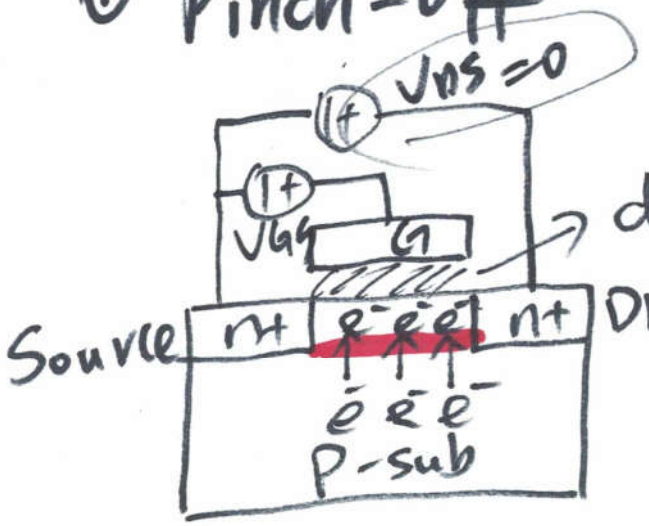
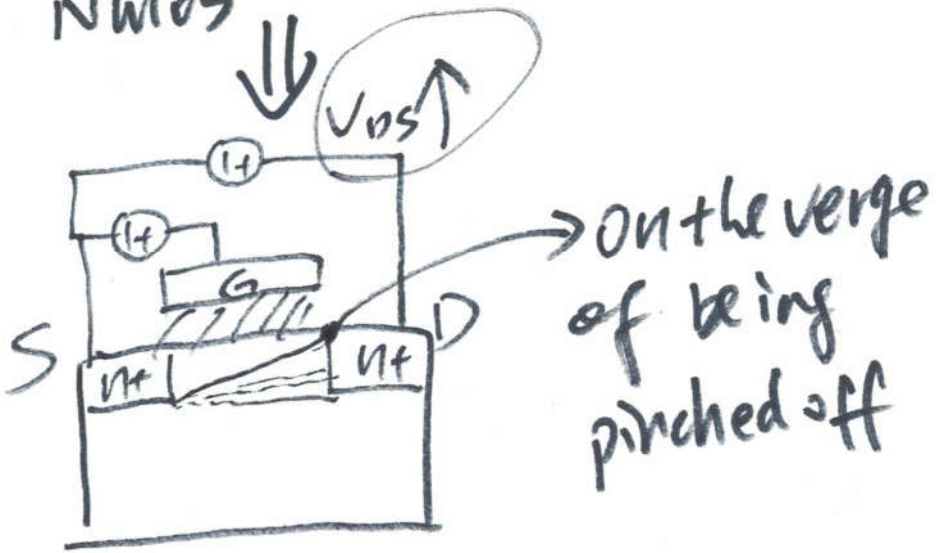
NMOS Operation

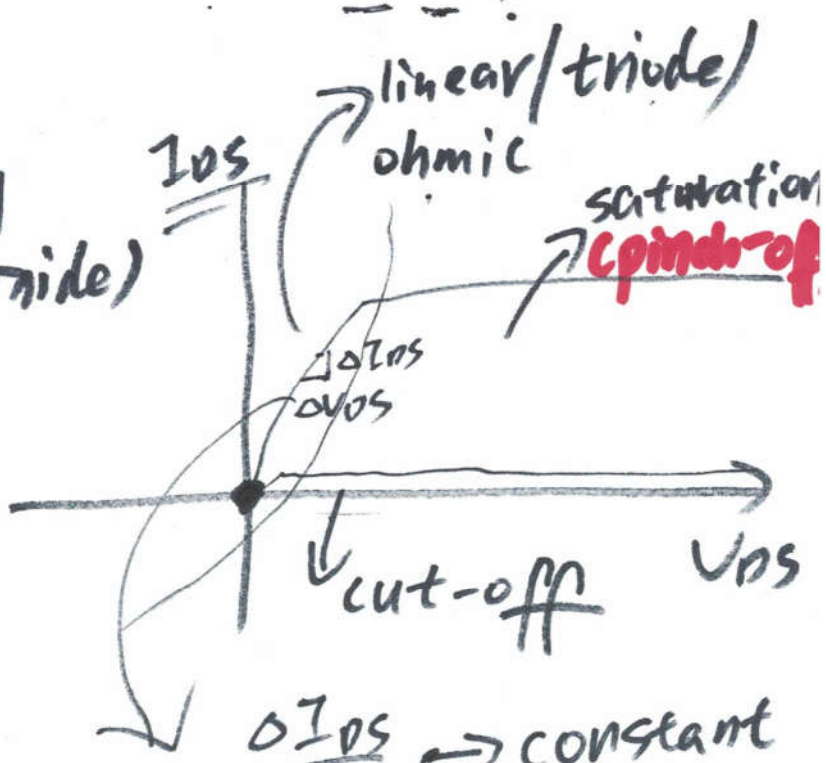
① Pinch-off

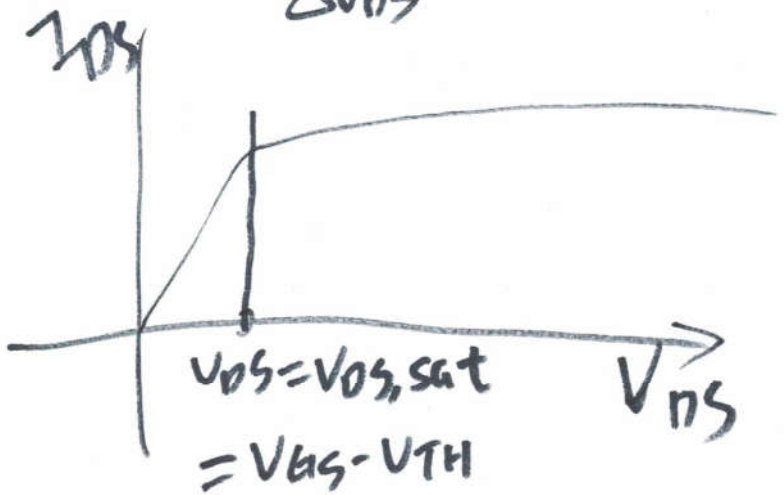


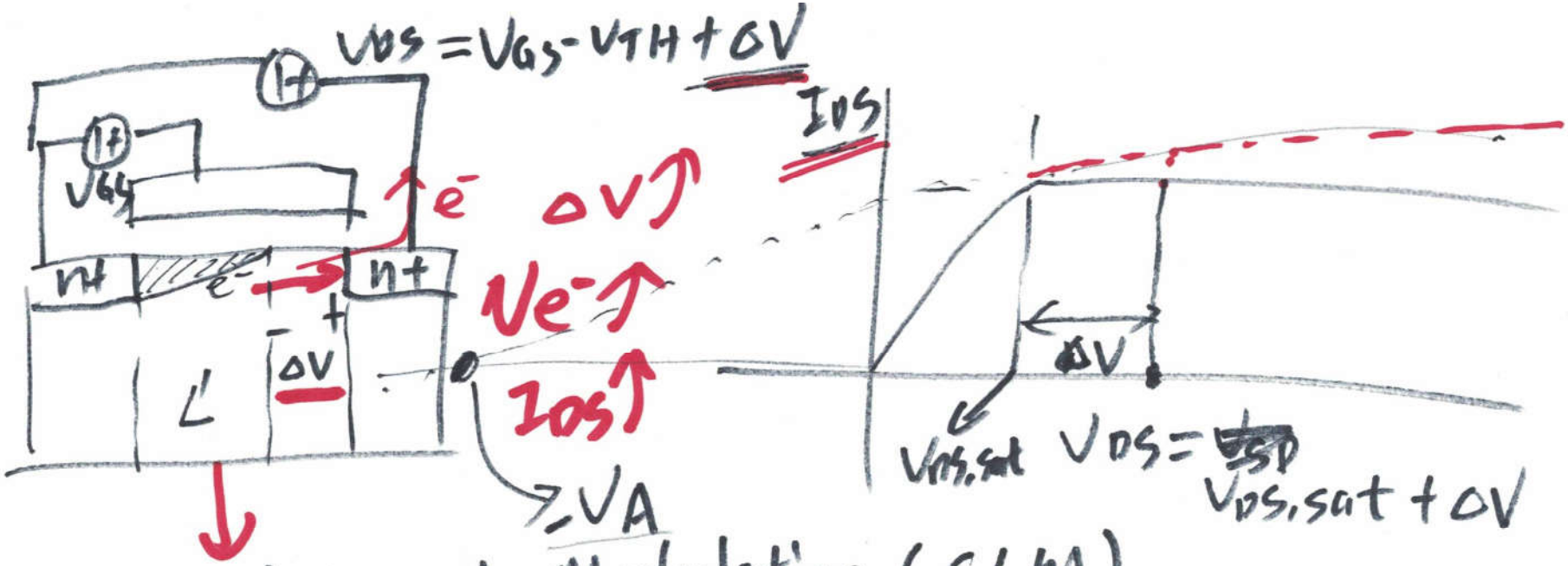
$V_{GS} > V_{TH}$ to turn on the NMOS



MOSFET



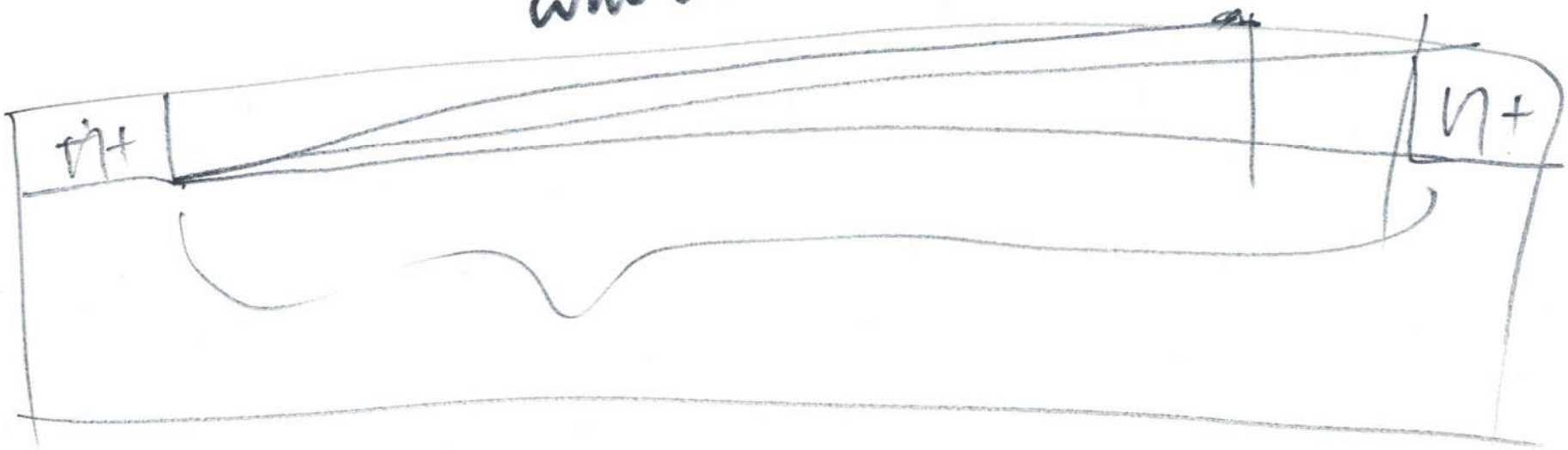




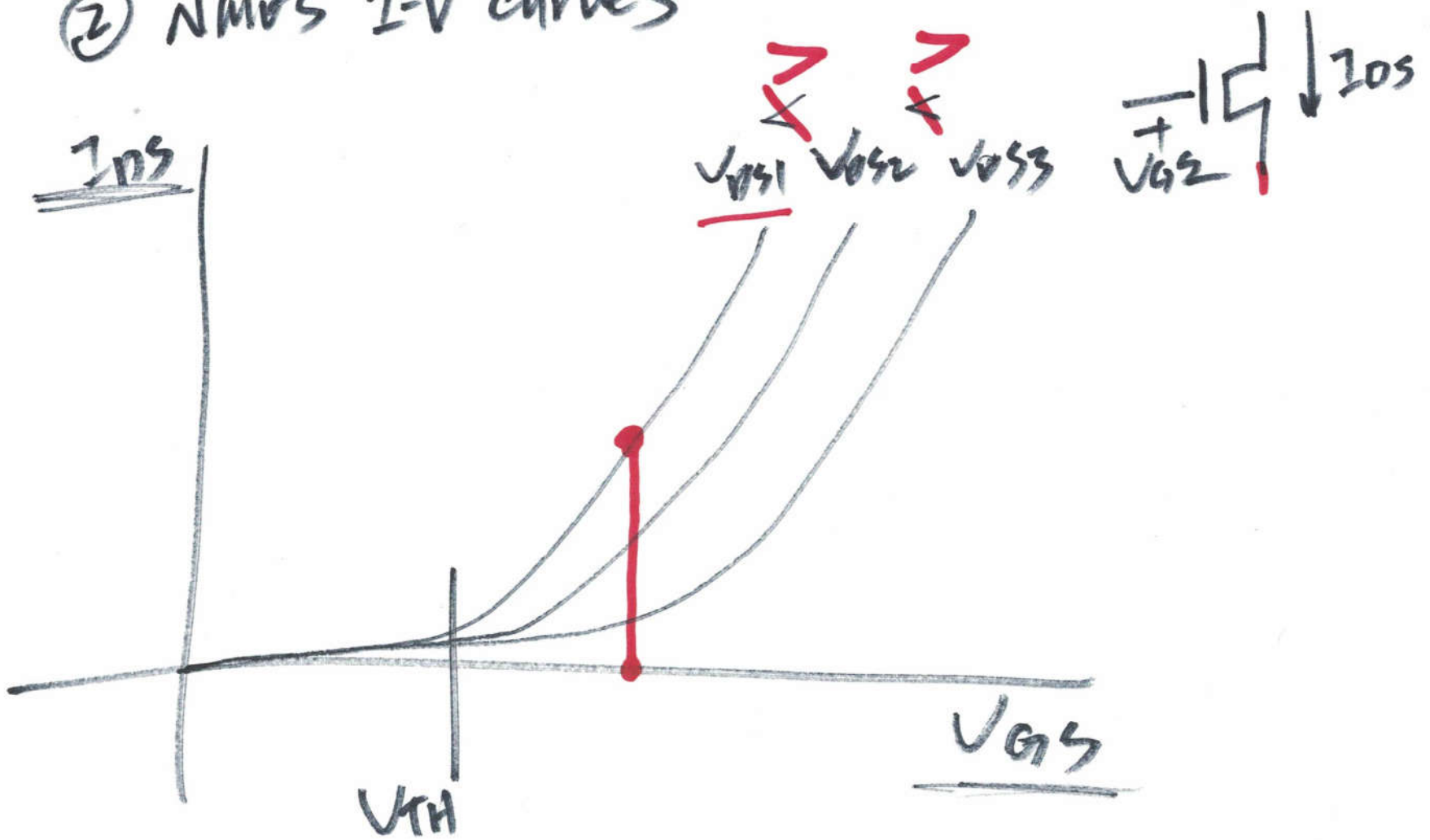
Channel Length Modulation (CLM)

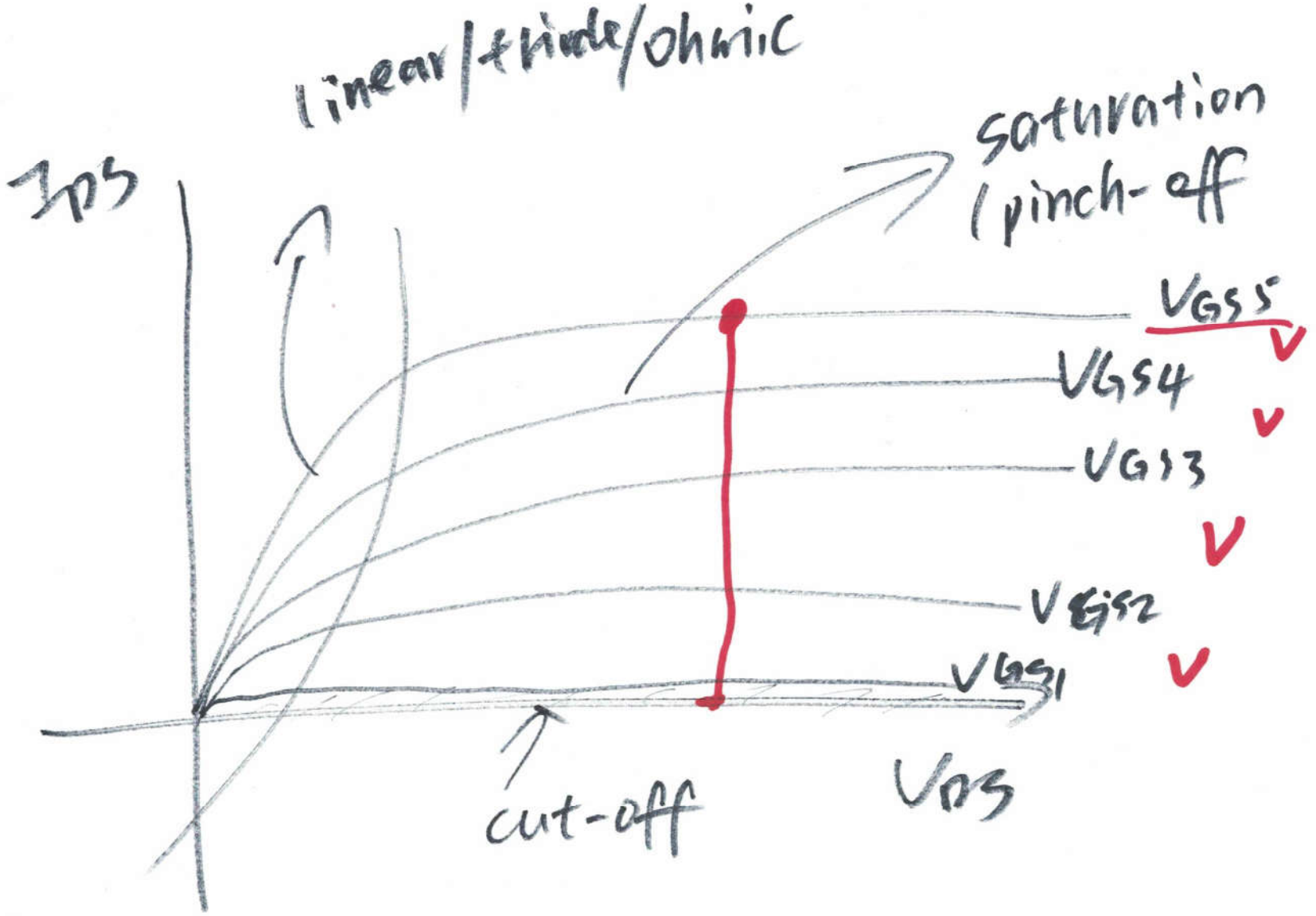
(~~Cut~~ Early Effect)

↳ (last name of the person who discovered this effect)

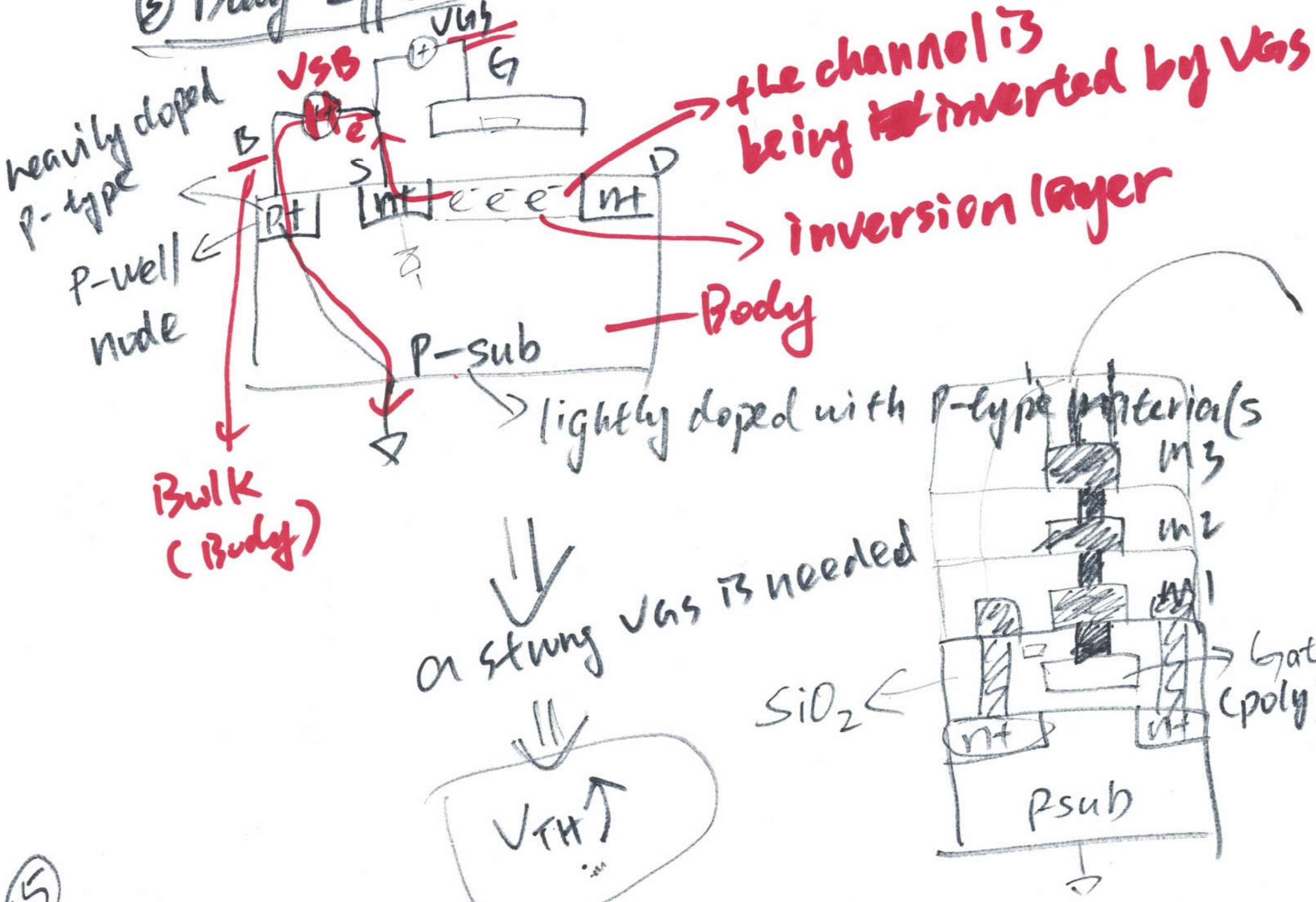


② NMOS I-V curves



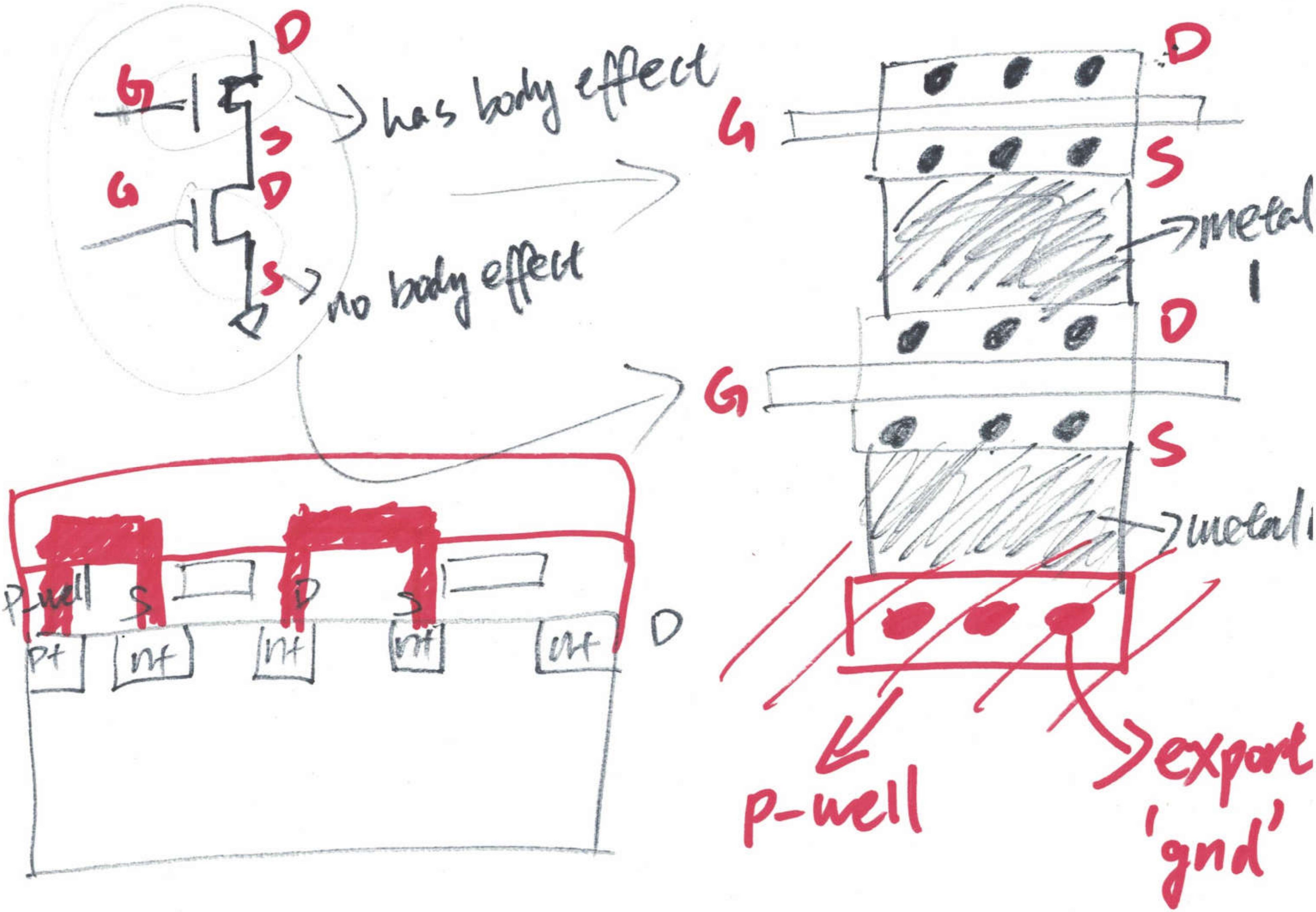

linear/triode/ohmic
saturation
pinch-off
I_{DS}
V_{GS5}
V_{GS4}
V_{GS3}
V_{GS2}
V_{GS1}
cut-off
V_{DS}

③ Body Effect



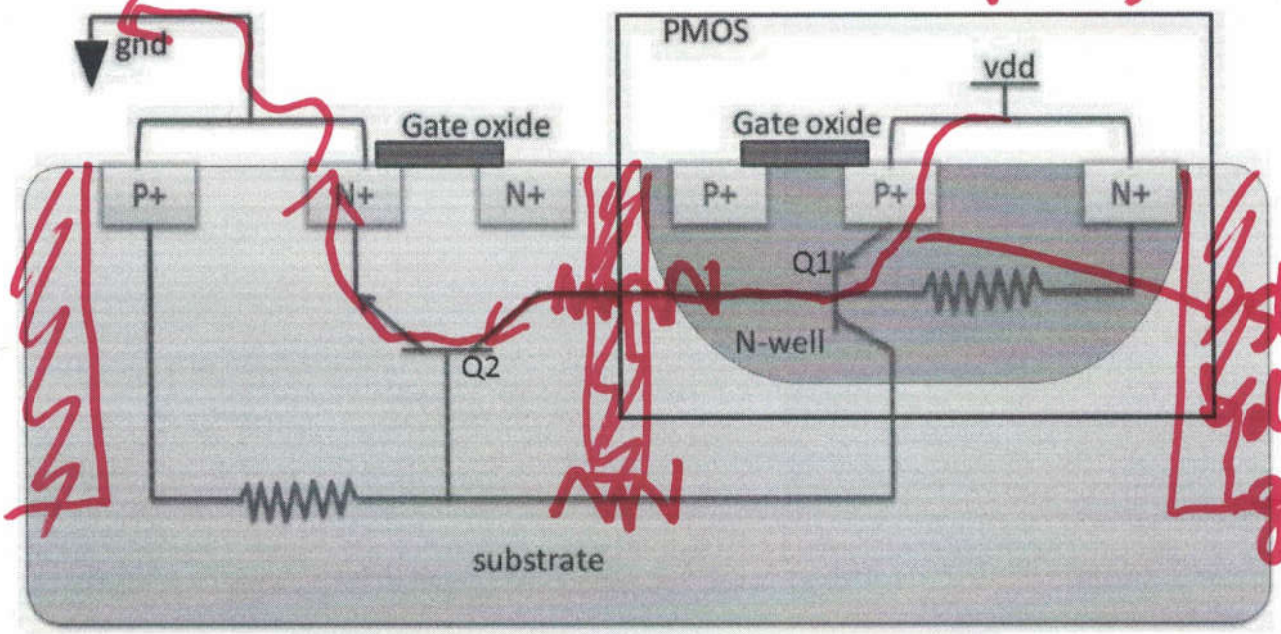
on strong VGS is needed

V_{TH} ↑


D
G
S
has body effect
G
D
S
no body effect
D
G
S
metal 1
D
G
S
metal 1
P-well
S
D
S
D
P+
n+
n+
n+
n+
p-well
export
'gnd'

④ Latch-up

P-N-P-N



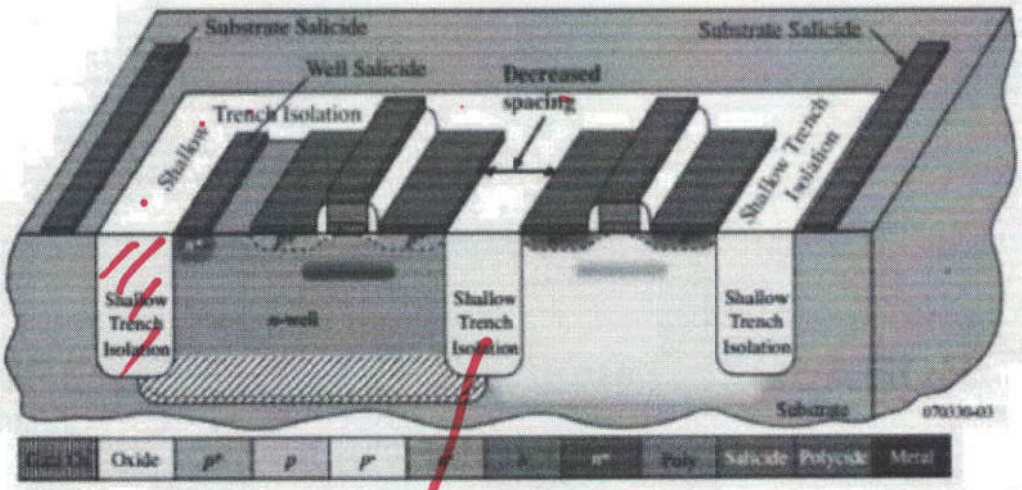
shorting gnd-to gnd

Figure 1 : Latchup formation in a CMOS device

USE OF SHALLOW TRENCH ISOLATION TECHNOLOGY

(STI)
↳ box isolation

- Use of Shallow Trench Isolation Technology: Shallow trench isolation (STI) allows closer spacing of transistors by eliminating the depletion region at the surface.



dielectric material made from SiO_2, high resistance

(B)